into the open park. Automatic records of wind direction at station No. 1 indicate that there is a movement of air from the San Francisco Mountains toward the valley at night.

The great differences in temperature observed are probably due to a combination of the two causes mentioned, the drainage of cold air from the steep slopes of the mountains undoubtedly playing an important part in the reduction of the temperature in the park. However, the same conditions will probably be found to exist in practically all of the parks in the forest since they are nearly all lower than the country immediately surrounding them.

The records of wind movement at stations Nos. 2 and 3 show that the average wind velocity is about twice as great in the park as in the forest.

The mean daily evaporation in the forest for the 4 months, from July 1 to October 31, was from 65 to 77 per cent of that in the park. The decreased evaporation in the forest is undoubtedly due to the decreased wind movement.

The protective influence of the forest on vegetation is strikingly illustrated by two small plantings of western yellow pine at meteorological stations Nos. 1 and 3. Fifty 2-year-old plants were set at each of these stations on April 22, 1909. On May 21, 90 per cent of the plants at station No. 3 were alive, while at station No. 1 only 11 per cent were alive. Soil samples taken on the same date showed a moisture content of 17 per cent at station No. 3, and 17.5 per cent at station No. 1, indicating that at both places the available soil moisture was ample to keep the plants alive. Nevertheless the appearance of the dead seedlings pointed to drought as the cause of their death. No records of evaporation are available for this period, but the wind movement at station No. 1 was practically twice as great as at station No. 3; there was but little precipitation, and the sky was generally clear. The inference is, therefore, that the plants at the edge of the forest, owing to the excessive evaporation, dried up in spite of the presence of abundant moisture at the roots, and that the relatively small loss in the forest was due to the protection against evaporation.

On large portions of the western yellow pine forests of this region the most serious silvicultural problem which the forester has to meet is that of regeneration, and the practical value of a forest cover in moderating two of the extreme physical conditions most unfavorable to forest regeneration, namely, excessive evaporation and, to a certain extent, frost, has been demonstrated by the observations at Fort Valley.

THE PETRIFIED FORESTS OF ARIZONA.

By Prof. F. H. BIGELOW.

In view of the interest in the subject of forests and climatology, it may be proper to recall a few of the well-known facts regarding the petrified forest in northern Arizona. A high escarpment of land, about 5,700 feet above sea level, stretches from Utah into northern Arizona. The Colorado River has cut its gorge across this escarpment, and to the southeast of the Colorado extends the plain of the Little Colorado on the top of this plateau the surrounding region being generally known as the Painted Desert. The Atchison, Topeka and Santa Fé Railroad crosses the escarpment to the south of the Grand Canyon, by way of Flagstaff, Holbrook, and Adamana. The station Adamana lies between the Rio Puerco and the Rio Zuni. About 10 or 15 miles south of the railroad station Adamana lies the famous petrified forest. It consists, as shown in the accompanying photographs (figs. 1–6), of massive tree trunks, generally coniferous, some from 100 to 200 feet in length and as much as 4 feet in diameter. Others are broken up into large blocks and scattered around quite irregularly. The entire country has been heavily eroded, so that the original horizontal plain, in which these trees grew, remains in only a few isolated places. However, the roots and some of the tree trunks, imbedded in the original soil, seem to have been found, the inference being that there has been no important transfer of the logs horizontally, such as would occur if they were floated in the water of the ancient rivers or seas, or such as would result from their rolling down the embankments into one place during the erosion of the region into high and low levels. The climatological history of this ancient forest is, of course, unknown, but it is inferred by Prof. F. Ward, who examined the region, that the trees must have grown in the Mesozoic or Triassic ages, so that they are many millions of years old. These tree trunks have now been transformed into agate, jasper, and chalcedony,

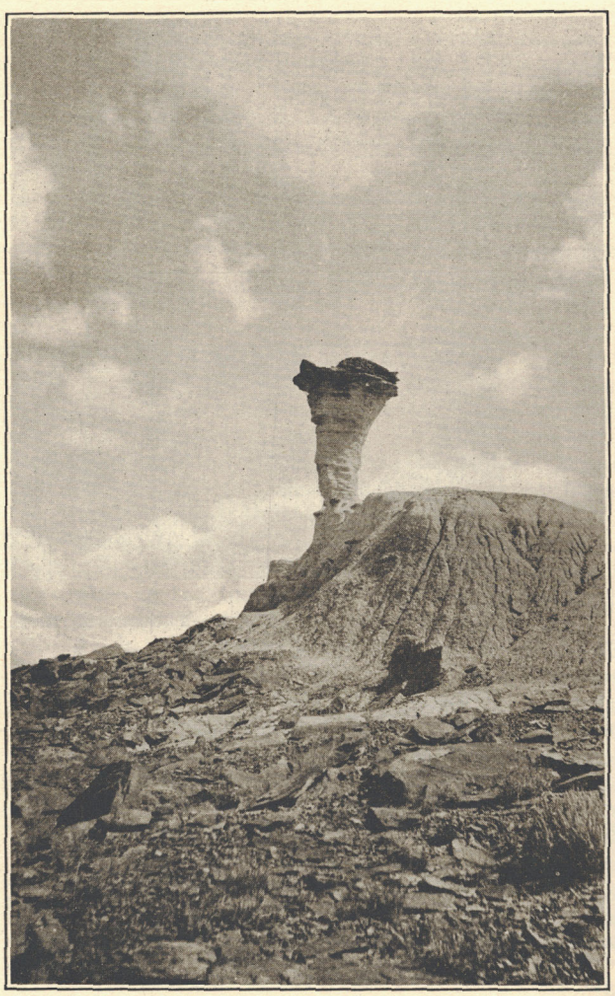

FIG. 1.—Eagle's Nest Rock. The pinnacle shows the height from which the entire region has been eroded by recent water action.

and their colors are very beautiful. Apparently they were submerged in the ancient waters, covered with sand, which on hardening embraced the logs and gradually turned them into stone by the absorption of silicates in solution. The region was then elevated probably from some low elevation as sea level to the height of nearly 6,000 feet, and the wearing away of the country through erosion has left them in their present condition.

The history of the Great Salt Lake, which is a remnant of the greater lake, Lake Bonneville, once about as large as Lake Michigan, this being of recent geological age, indicates that the entire region of the western portion of the United States was altogether different in its formation from what we now know it. The Rocky Mountains on the eastern side of the plateau apparently bore something of the same relation to the prevailing westerly winds that the Sierra Nevada Mountains now do to the Pacific Ocean and its winds, the Sierra Nevada Mountains

FIG. 2.—Blocks of tree trunks. The trees are all conifers.

FIG. 3.—These tree trunks are about 150 feet in length and 2½ feet in diameter.

FIG. 4.—This tree trunk is several million years old and has become petrified by the deposit of water salts in the wood.

FIG. 5.—Dewey's Cannon, overlooking an eroded valley. The imperfections in the trunk and the bark are preserved to the minutest detail.

having been formed since the eastern or Rocky Mountain Range. As the sequoias flourish on the western slope of the Sierra Nevada so apparently the western slope of the Rocky Mountains were once covered with trees of a large growth. It can easily be inferred that the forestation always changes with the climatic variations, which are due to the general topography of the mountains as referred to the prevailing winds bearing moisture content to be precipitated on the mountain slopes. It is probable that the forest regions now known to exist will gradually change their habitat if terrestrial climates undergo any important modification, due to the change in the land masses, and to the corresponding deflection of the great vapor bearing winds, which are in turn dependent upon the general circulation of the atmosphere.

FIG. 6.—This tree trunk forms a bridge over the ravine which has been washed away from the sandstone.